Economics 101
Fall 2017
Answers to Homework #3
Due Tuesday, October 31, 2017

Directions:

- The homework will be collected in a box **before** the lecture.
- Please place **your name, TA name, and section number** on top of the homework (legibly). Make sure you write your name as it appears on your ID so that you can receive the correct grade.
- Late homework will **not** be accepted so make plans ahead of time.
- **Show your work**. Good luck!

Please realize that you are essentially creating "your brand" when you submit this homework. Do you want your homework to convey that you are competent, careful, and professional? Or, do you want to convey the image that you are careless, sloppy, and less than professional? For the rest of your life you will be creating your brand: please think about what you are saying about yourself when you submit any work for someone else.

Part I: Excise Taxes

1) Under the influence of President Trump's "Buy American, Hire American" policy, Foxconn, a Chinese company has pledged that it will build an LCD-manufacturing facility in Wisconsin, which represents a $10 billion investment. This facility is expected to create between 3,000 and 13,000 jobs and should be up and running by 2020. Suppose the market for LCD screens in Wisconsin after Foxconn comes can be described by the following supply and demand curves:

Demand: $P = 660 - 3Q$
Supply: $P = 60 + 2Q$

where Q is the quantity of LCD screens and P is the dollar price per unit of LCD screen:

a. Given the above information, find the market equilibrium price and quantity. Then calculate Consumer Surplus (CS), Producer Surplus (PS) and Total Surplus (TS).

Solution:
In equilibrium, we know that the quantity supplied equals the quantity demanded. Set the demand equation equal to the supply equation: 660 – 3Q = 60 + 2Q. We get an equilibrium quantity, Q = 120 LCD screens. By plugging this result back into either of two equations, we find the equilibrium price, P = $300 per LCD screen.
Consumer surplus is the area of the triangle above the price consumers pay, and below the demand curve. The height of the triangle is the P - intercept of demand minus the equilibrium

price ($660 per LCD screen – $300 per LCD screen = $360 per LCD screen). The base is the quantity purchased (Q = 120 LCD screens). Thus,
CS = (1/2) *360*120 = $21,600.
Producer surplus is the area of the triangle below the price producers receive and above the supply curve. The height of the triangle is the price minus the P - intercept of supply ($300 per LCD screen – $60 per LCD screen = $240 per LCD screen). The base is as before. PS = (1/2) *240*120 = $14,400.
Total surplus equals the sum of consumer surplus and producer surplus. Thus,
TS = CS + PS = 21,600 + 14,400 = $36,000

Suppose that Governor of the state considers the LCD screen market as a potential government income source and decides to impose an excise tax of $50 per screen on all producers.

b. Given this excise tax, find the new price that consumers will pay for a LCD screen in this market, the new price producers will receive for a LCD screen in this market, and the new equilibrium quantity of LCD screens that will be sold.

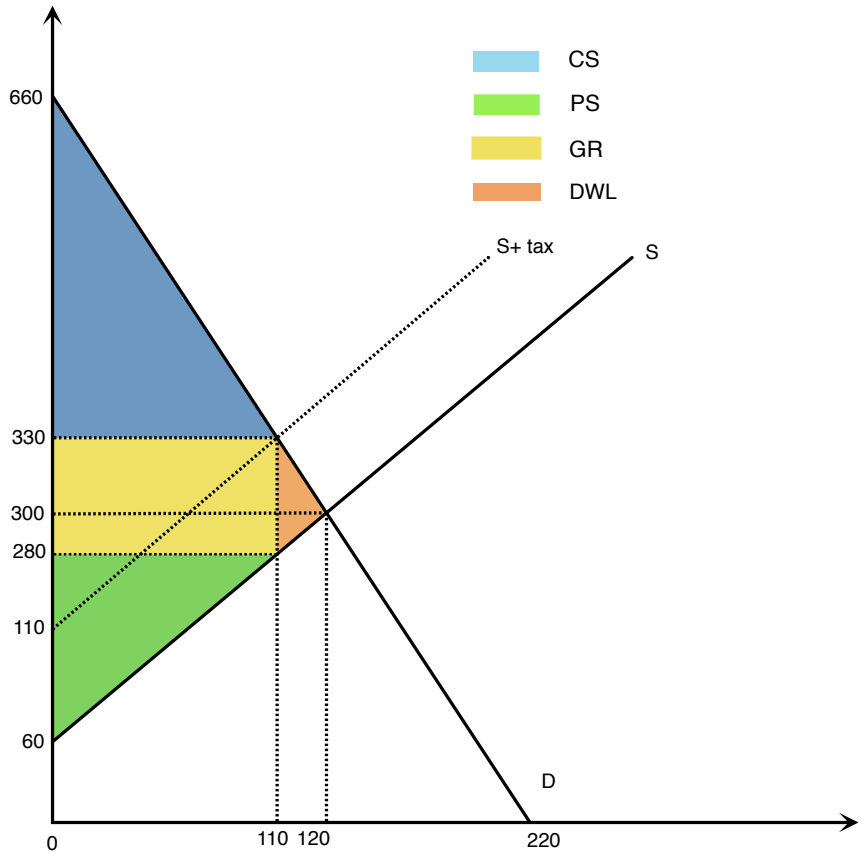
Solution:
The tax has the effect of adding a $50 per unit cost to suppliers, shifting the supply curve upward. The original supply curve had a P - intercept of $60, so the new will have a P - intercept of $110. The slope is unchanged, so using this information we can determine that the new supply curve will be P = 110 + 2Q.
As before solving for the equilibrium price and quantity. You should find Pt = $330 per LCD screen and Qt = 110 LCD screens. Then the new price consumers will pay is $330.
The price producers will receive equals the new equilibrium price minus the excise tax. Thus
Pnet = $330 per LCD screen – $50 per LCD screen = $280 per LCD screen.

c. Given this excise tax, calculate the value of Consumer Surplus with tax (CSt), Producer Surplus with tax (PSt), tax revenue the government receives from implementing the tax (Tax Revenue), Total Surplus with tax(TSt) and the Deadweight Loss (DWL) due to the implementation of this excise tax.

Solution: (A graph of the solution follows the explanation)
Consumer surplus with the tax is the area of the triangle above the price consumers pay for a LCD screen, and below the demand curve. The height of the triangle is the P - intercept of demand minus the new equilibrium price ($660 per LCD screen – $330 per LCD screen = $330 per LCD screen). The base is the quantity purchased (Q = 110 LCD screens). Thus,
CSt = (1/2) *330*110 = $18,150.
Producer surplus with the tax is the area of the triangle below the price producers receive when they sell a screen and above the supply curve. The height of the triangle is the price they receive minus the P - intercept of supply ($280 per LCD screen – $60 per LCD screen = $220 per LCD screen). The base is as before. So
PSt = (1/2) *220*110 = $12,100.
Government's tax revenue equals to the tax per screen times the new equilibrium quantity, thus

Tax Revenue = ($50 per LCD screen) *(110 LCD screens) = $5500.
Total surplus is the sum of CS, PS and government tax revenue, so
TS = CS + PS + Tax Revenue = 18150 + 12100 + 5500 = $35,750
Deadweight Loss is the difference between the TS without the tax and with the tax, thus
DWL = 36,000 – 35750 = $250

In the graph below, price per LCD screen (P) is measured on the vertical axis and quantity of LCD screens (Q) is measured on the horizontal axis.



d. Suppose the government decides to implement an excise tax in this market so that consumption of LCD screens drops to 100 units. Calculate the size of the excise tax that will be needed (assume that there is no initial excise tax) for the government to hit the target. Show how you derived your answer.

Solution:
The government wants Qt to equal 100 units. Producers are willing to supply this quantity at a price of:
P = 60 + 2Qt = 60 + 2*100 = $260 per LCD screen
Consumers are willing to buy this quantity at a price of:
P = 660 – 3Qt = 660 – 3*100 = $360 per LCD screen

To figure out the excise tax we need to set the excise tax per unit = (price consumers are willing to pay for Qt) – (price producers must get to supply Qt) or
Excise Tax per unit = 360 - 260 = $100 per LCD screen.

Part II: International Trade

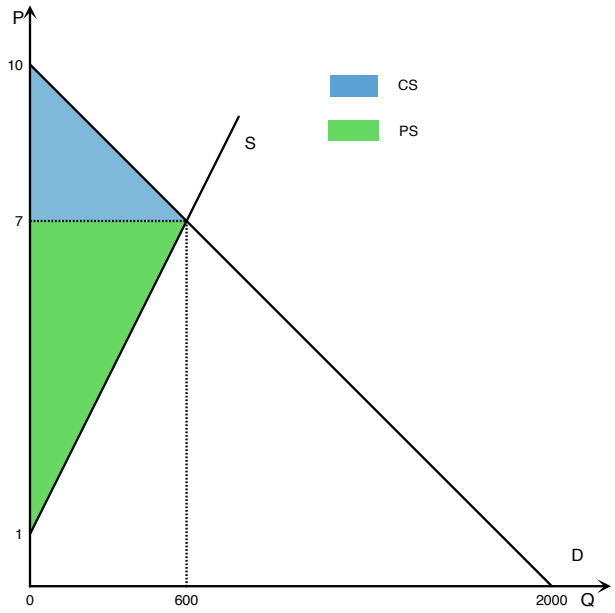
2) The Vuvuzela is a kind of plastic horn. After the 2010 FIFA World Cup, it became a symbol of South African soccer as the stadiums in South Africa are often filled with its sound. The domestic demand and supply for Vuvuzela in South Africa are given by the following equations where Q is the quantity of Vuvuzelas and P is the price in dollars per unit of Vuvuzela:

Domestic Demand: $P = 10 - \frac{1}{200}Q$

Domestic Supply: $P = 1 + \frac{1}{100}Q$

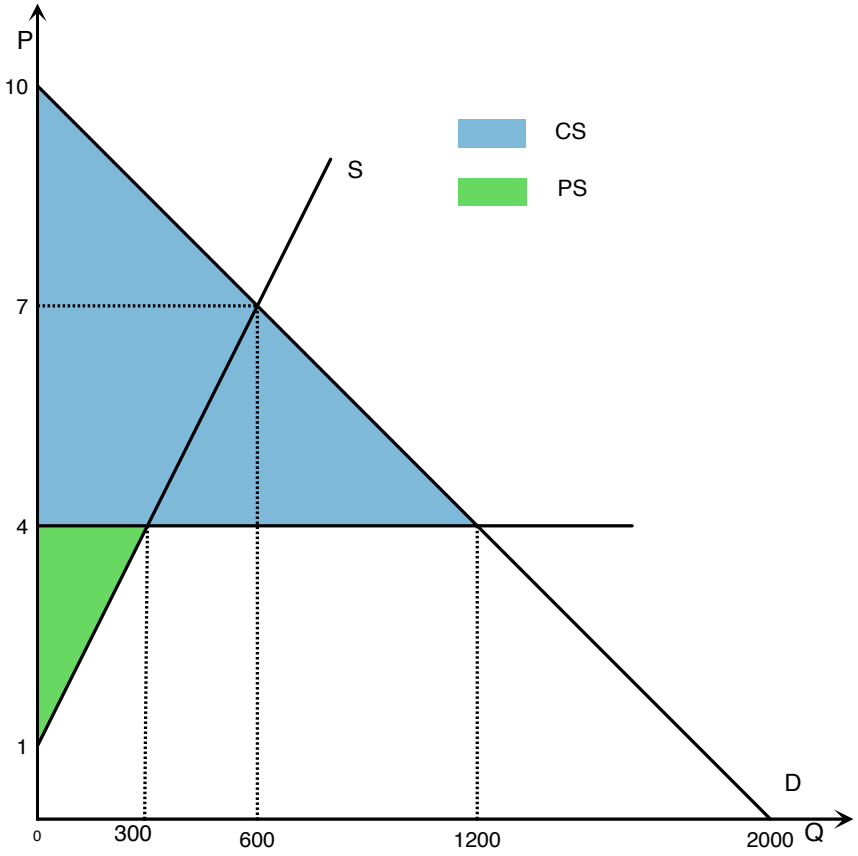
a. Calculate the equilibrium price, quantity, Consumer Surplus (CS), Producer Surplus (PS) and Total Surplus (TS) for the domestic market of Vuvuzelas when South Africa is in autarky (i.e. the market is closed to trade). Illustrate your answer graphically.

Solution:
To find the equilibrium point, follow the usual method: set supply equal to demand.
10 – (1/200) Q = 1 + (1/100) Q
We find Q = 600 Vuvuzelas. Plugging this back into either supply or demand, we find P = $7 per Vuvuzela.
Consumer surplus is the triangle below the demand curve but above the equilibrium price. The P - intercept of demand is $10 per Vuvuzela and the equilibrium price is $7 per Vuvuzela, so the height of the triangle is $3 per Vuvuzela. The base length is simply the equilibrium quantity. Thus,
CS = (1/2) *3*600 = $900
To find producer surplus, we can follow a similar method to find the area of the triangle below equilibrium price but above the supply curve. The P - intercept of supply is $1 per Vuvuzela and the equilibrium price is $7 per Vuvuzela, so the height of the triangle is $6 per Vuvuzela. The base length is simply the equilibrium quantity. Thus,
PS = (1/2) *6*600 = $1800
Total surplus is merely the sum of the two so,
TS = 900 + 1800 = $2700



b. Suppose South Africa now opens it Vuvuzela market to international trade and the world price for vuvuzela is $4 per Vuvuzela. Furthermore, suppose the market for Vuvuzelas in South Africa is small relative to the global market. Given this information, what is the new market price in South Africa? How many Vuvuzelas will be consumed domestically in the South African market? How many Vuvuzelas will be imported/exported? Calculate the new Consumer Surplus, Producer Surplus and Total Surplus when the market for Vuvuzelas opens in South Africa. Illustrate your answers graphically.

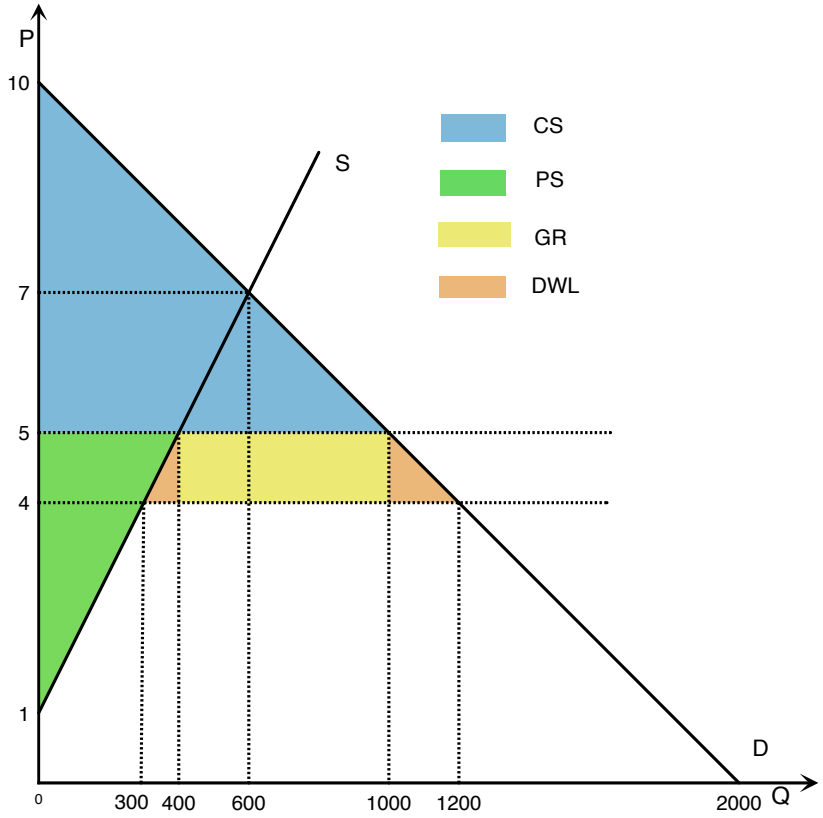
Solution:
From part (a) we know the market price without trade is $7 per Vuvuzela, which is above the world price, thus the price in South Africa with trade will be the world price of $4 per Vuvuzela.
Plugging this into the supply and demand curves we find
4 = 10 – 1/200 Qd, so Qd = Quantity demanded domestically in South Africa = 1200 Vuvuzelas;
4 = 1 + 1/100 Qs, so Qs = Quantity supplied domestically in South Africa = 300 Vuvuzelas.
Since the domestic quantity demanded is 1200 Vuvuzelas, and the domestic quantity supplied is only 300 Vuvuzelas, the difference must be made up by imports. Thus
Imports = 900 Vuvuzelas
Consumer Surplus is the triangle above the world price and below the demand curve, so
CS = (1/2) *6*1200 = $3600
Producer Surplus is the area below the world price and above the supply curve, so
PS = (1/2) *3*300 = $450
TS = CS + PS = $4050



c. Suppose South Africa government, fearing that the domestic Vuvuzela industry is unduly suffering from the influx of cheap foreign Vuvuzelas, decides to implement a $1 per unit tariff on imports. What is the new price for a Vuvuzela in the domestic market, the quantity consumed, the quantity imported, the Consumer Surplus, Producer Surplus, Government Tariff Revenue, Total Surplus and Deadweight Loss due to the imposition of this tariff? Illustrate your answers graphically.

Solution:
Since the tariff is $1 per Vuvuzela, the domestic price will be $1 per Vuvuzela more than the world price, thus P = $5 per Vuvuzela.
Plugging this into the demand curve, we find the quantity domestically demanded is 1000 Vuvuzelas.
Plugging this into the supply curve, we find the quantity domestically supplied is 400 units. This implies that imports are now equal to 600 Vuvuzelas.
We can calculate Consumer Surplus and Producer Surplus in the usual manner, finding
CS = (1/2) *5*1000 = $2500
PS = (1/2) *4*400= $800
Since the tariff is $1 per Vuvuzela imported, and 600 Vuvuzelas are imported we know Tariff Revenue must be
Tariff Revenue = 1*600 = $600

Total Surplus is CS + PS + Tariff Revenue, so
TS = 2500 + 800 + 600 = $3900
Deadweight Loss is the difference between the TS without the tariff and with the tariff, thus
DWL = 4050 – 3900 = $150
Alternatively, you can calculate DWL as the area of the two brown triangles in the graph.



d. Provide an intuitive explanation for the sources of deadweight loss under this tariff.

Solution: From the graph, we can see there are two deadweight loss triangles. The one on the right (under the demand curve) can be thought of as deadweight loss from some consumption being lost due to the tariff. The one on the left (under the supply curve) can be thought of as loss from the reallocation of productive resources. In the absence of the tariff, the only domestic production was by firms who could produce more efficiently than the firms on the international market. The remaining firms would have then put the unused resources towards production of a good for which they had a comparative advantage against the rest of the world. With the implementation of the tariff, some domestic resources that could have been better used elsewhere are now required for the production of Vuvuzelas.

e. Suppose the government of South Africa is very corrupt and that the government's concern is only about the amount of tariff revenue they collect. What is the tariff that maximizes the government's tariff revenue? Find the revenue-maximizing tariff.

Solution:

Government revenue equals the tariff times the number of Vuvuzelas imported. When government sets the tariff to be $x dollar per unit, the domestic price will be the world price plus the tariff, thus
P = 4 + x.
Plugging this into the demand and supply curve, we find
4 + x = 10 – 1/200 Qd, so Qd = 1200 – 200x;
4 + x = 1 + 1/100 Qs, so Qs = 300 + 100x.
Then we have Imports = Qd – Qs =1200 -200x – (300 +100x) = 900 – 300x;
And Government Tariff Revenue = x (900 – 300x),
We find that Government Tariff Revenue is a quadratic function in x and reaches its maximum at x = 900 / (2*300) = 1.5.
So, a tariff of $1.50 per Vuvuzela will maximize the government's tariff revenue. Suppose you don't recall how to find the answer using a quadratic function….is there another way to do this? We could use calculus. Or we could just try some numbers: if x = $1 per Vuvuzela, we know that tariff revenue is going to be $600 (from (d)). If the tariff was $2 per Vuvuzela, we would find that the tariff revenue was $600. What about if the tariff was $1.50 per Vuvuzela? Solving this, we would find that the tariff revenue was $675.

3) Kyber crystal is the key raw material to produce lightsabers. And Jedha is a small desert moon (can be viewed as a small economy) which orbits the planet NaJedha. Suppose that the domestic supply and demand for Kyber crystal in Jedha are given as follows:

Domestic Demand: $Q = 420 - 5P$
Domestic Supply: $Q = 3P - 60$

where Q is the quantity of Kyber crystals and P is the price per Kyber crystal.

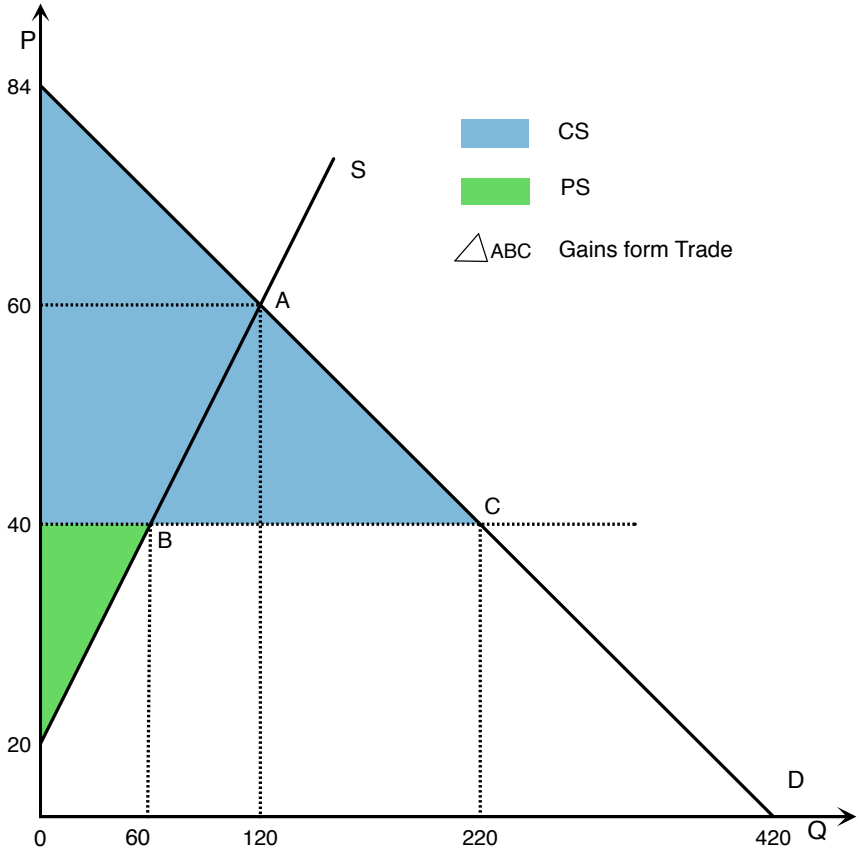
a. What is the equilibrium price and quantity in autarky (remember "autarky" is the term used to describe a closed market)? Also calculate the Consumer, Producer, and Total Surplus.

Solution:
Follow the usual procedure. Set supply equal to demand:
420 – 5P = 3P – 60
So P = 60 per Kyber crystal. Plugging this back into supply or demand, we find Q = 120 Kyber crystals.
We can calculate Consumer Surplus and Producer Surplus in the usual manner, finding
CS = (1/2) *(84 – 60) *120 = $1440
PS = (1/2) * (60 – 20) *120= $2400
And TS = CS + PS = 1440 + 2400 = $3840

b. Jedha now decides to enter the international market for Kyber crystal. Once the market clears, we find that Jedha imports 160 units of Kyber crystal. Given this fact, what is the world price for

a Kyber crystal? What is the new consumer, producer, and total surplus in Jedha's open market for Kyber crystals? And what is the value of the gains from trade that Jedha experiences when it opens it Kyber crystal market to trade? Illustrate your answers graphically.

Solution:
We know imports are 160 Kyber crystals. This implies that the domestic quantity demanded, Qd, is 160 more than the domestic quantity supplied, Qs, i.e.,
$Qd = Qs + 160$
we get
$(420 – 5P) = (3P – 60) + 160$
Simplifying we get
$8P = 320$
Thus, the world price must be P = $40 per Kyber crystal. And we can find
$Qd = 420 – 5*40 = 220$, $Qs = 3*40 – 60 = 60$ Kyber crystals
To find Consumer and Producer surpluses, we proceed as before, but now CS is a much larger triangle and PS a smaller one (see graph below).
$CS = (1/2) *(84 – 40) *220 = \$4840$
$PS = (1/2) * (40 – 20) * 60 = \$600$
$TS = 9000 + 1000 = \$5440$
Gains from trade is the difference between TS with trade and TS without trade (in autarky), thus
Gains from Trade = 5440 – 3840 = $1600
Notice, without international trade, total surplus would be the triangle to the left of the domestic equilibrium, above $20 and below $84. Thus, from the graph, we can see that the gains from trade can be represented by the triangle below the domestic equilibrium point and above the world price, between the supply and demand curves.



c. Now suppose the government decides to set an import quota of 200 units of Kyber crystals; i.e. only 200 units of Kyber crystals may be imported in to Jedha. What is the new equilibrium price, quantity, surpluses (CS, PS and TS) and deadweight loss due to the imposition of this import quota?

Solution:
From part (b) we know only 160 units would be imported in the absence of regulation. Thus, if the government limits imports to 200 units, the policy has no effect. Then price, quantity, imports, and surpluses are all as they were in (b) when the market was open to trade.
Similarly, there is no deadweight loss since the outcome is the same as the unregulated one.

d. Now suppose the government decides to set an import quota of 80 Kyber crystals; i.e. only 80 Kyber crystals may be imported. What is the new equilibrium price, quantity, surpluses (CS, PS and TS), license holder revenue and deadweight loss due to the imposition of this import quota? Illustrate your answers graphically.

Solution:
First, we find the equilibrium price with the quota noting the fact that, at the equilibrium price
$Qd = Qs + Quota$
$420 - 5P = (3P - 60) + 80$

420 – 5P = 3P + 20
Solving for P we find P = $50 per Kyber crystal.
By plugging 50 into the demand curve, we find the quantity consumed domestically is 170 units.
80 are imported (up to quota), so domestic supply is 90 units.

Consumer Surplus is the usual triangle (see plot) so
CS = (1/2) *(84 – 50) *170 = $2890
Similarly for Producer Surplus
PS = (1/2) *(50 – 20) *90 = $1350

License holder revenue is the number of imported units (the quota) times the difference between the domestic price and the world price (the importer buys Kyber crystals at the world price and sells them at the domestic price, netting the difference).
License Holder Rev = 10*80 = $800

Total surplus is the sum of CS, PS, and License - Holder Revenue so
TS = 2890 + 1350 + 800 = $5040
Recalling that TS before the quota was $5440, we see that the DWL must be $400.
Alternatively, you could calculate the area of the DWL triangles from the graph.